**Template | Unit Enhancement**

***ENGINEERING DESIGN***

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**Background Information**

**Instructional Materials Title: *Populations & Ecosystegms***

**Publication Date: 2004**

**Work Group Participants: 7th RSD cohort (Michelle Opiniano, Rachel Peach, Steve Turner, Mallie Mayfield, Brett Carr, Crystle Selden)**

**Date Developed: Aug.22, 2013**

**High Leverage Lesson (Title and Page Number): Investigation 3, pg.81**

**Rationale**

· **It lends itself to engineering (build an ecosystem)**

**- NGSS –**

**MS-LS2-5 Evaluate competing design solutions for maintaining biodiversity…)**

**MS- ETS1-2 Evaluate competing design solutions using a systematic process to determine how well they meet the criteria and constraints of the problem.**

* **WA**

**6-8 SYS A, B, D (Identify subsystems, boundaries, inputs; open vs. closed)**

**6-8 LS2 A, B, C, D (Define ecosystem parts, boundaries; analyze energy flow; animals need plants; predict ecosystem response to change of a factor)**

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***Engineering* Lesson Enhancement**

**Overview**

· **Students will design, defend, and construct an ecosystem that is an improvement of an initial ecosystem.**

· **Investigation #3 with few modifications (see below). The lesson is framed with design language, and students are given a chance to design an improved ecosystem.**

· **The design is revisited during Investigation #5, and students may make additional design changes with their new knowledge.**

· **Key instructional strategies and tools needed**

**Part 1: Lesson Modifications to Lead Up to *Engineering Task***

1. Introduce new vocabulary:
   1. Sustainable
   2. Biodiversity
   3. Major aspect
   4. Design/engineering terminology
2. Modifying part 3 so that students design the initial ecosystem (instead of following procedures in guide).

**Part 2: *Engineering* Learning Sequence**

1. Discuss the design challenge and connection to authentic scientific practice.
2. Student teams make and defend a design 🡪 record this design and reasoning!
3. Class “Design #1” is built. (teacher can decide what Design #1 will be)
4. Study Design #1 (population counts, etc.)
   1. What are we learning about ecosystems?
   2. Evaluate how well the Design #1 is working.
5. (Investigations #4 & 5 completed while step 4 occurs)
6. Teams redesign (and reasons) Design #1 with new criteria (they can still use original team designs in their thinking and argumentation) 🡪 Class Design #2 is decided & built.
   1. Again track the ecosystem to see how well it is working, and why.

**Part 3-A: Engineering Task -** *Describe the Engineering Task that students will engage in.*

**Design Challenge** = You are a zookeeper that was recently assigned the task of constructing an aquatic habitat exhibit for several populations. Your goal is to build a ***sustainable*** ecosystem that is ***biologically diverse.***

**Success Criteria**:

* + All populations stay alive for as long as possible.

**Constraints**:

* + No human-added food (if food is needed, the design solution will need to be revised)
  + Aquatic ecosystem
  + All populations on “the list” must be represented.
  + Limited to FOSS-supplied materials.

**Part 3-B: Assessment Rubric**

* Use data to evaluate and refine design solution.
  + Formative, non-assessment grade (teacher can determine process/product)
    - i.e. double bubble, Venn diagram (w/ reasoning), other graphic organizers, etc.
* Engages in argument to successfully to identify the best solution to a design problem
  + Formative, non-assessment grade (teacher can determine process/product)
    - Oral class discussion of own group’s design
    - Written, individual argument for a design #2
* Make a claim about the merit of a solution to a problem by citing relevant evidence about how it meets the criteria and constraints of the problem
  + Summative, assessment grade
  + Written response using provided rubric:
    - Prompt:

Now that you have re-designed your aquatic habitat, write a proposal to the zoo explaining why your new design is better than the first design.

Be sure to:

* + - * include how the proposed solution (including changes made and things kept the same) will better meet all criteria and constraints
      * support all major aspects of the design (including changes made and things kept the same) with relevant evidence from design #1.
      * Apply the science concepts you’ve learned to justify the major aspects of the design (including changes made and things kept the same)
* Obtain and combine information from books and/or other reliable media to explain phenomena or solutions to a design problem
  + Summative, assessment grade, will use the same rubric as the previous standard.

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**Additional Information**

Possible data for students to collect with design #1:

population counts, behavior obs., abiotic and biotic interactions, abiotic measurements [temp, pH., water quality, light, etc.], health/conditions of organisms, level of human input (measure amnt and freq. of food given, etc.